

Captive Husbandry of the Solomon Island Prehensile-Tailed Skink, *Corucia zebra*

Kevin M. Wright, DVM
Philadelphia Zoological Gardens
3400 W. Girard Avenue
Philadelphia, PA 19104

Introduction

The prehensile-tailed skink, *Corucia zebra*, is a very large, green, arboreal skink with a strong prehensile tail. Adult animals have snout to vent lengths between 25 and 35 cm and the tail length is often over 35 cm. Adult weights are generally between 500 and 700 grams. This species possesses a truly prehensile tail, an uncommon feature found in only a few families of lizards (notably the Anguidae, Geckonidae, Iguanidae, Scincidae and Varanidae). Other traits that are unusual for a skink include its arboreal habits, herbivorous diet and crepuscular to nocturnal activity pattern. Early evening is the time of greatest activity for most individuals, although some maintain bimodal peaks of activity at dawn and dusk. Female skinks will tend their young for several days post-partum, aggressively attacking intruders and guiding the young to food. Most individuals become accustomed to gentle handling although a few remain pugnacious and will bite at the slightest provocation. Prehensile-tailed skinks have a longevity of at least ten years in captivity, and some individuals have reached ages of more than fifteen years. Presently the skinks are readily available in the pet trade, but as a result of the intensive logging efforts on the Solomon Islands this species recently was upgraded by the Convention on the International Trade in Endangered Species (CITES) to level II (species considered threatened).

The background color of an adult prehensile-tailed skink varies from olive to jade green. This may be interrupted by light green to bronze crossbands, hence the specific name *zebra*. Some animals are heavily speckled with black pigment. The degree and intensity of striping and

speckling varies between populations of skinks on different islands. There is some debate as to whether this variation is significant enough to warrant subspecies designations, since the color patterns and possibly scutellation may vary among animals from different islands (1). The fertility of mating animals from geographically separate populations may be rather low if a genetic drift has caused much divergence in the gene pools on various islands. To minimize this possibility when assembling a breeding colony of prehensile-tailed skinks it is probably best to purchase animals in groups originating from the same island. Since this is impossible for most herpetoculturists, given the importation procedure followed by animal dealers, it is recommended that animals are acquired with similar morphologic features such as size and color pattern. It is hoped that further study will clarify the issue of subspecies.

It may be difficult for the novice to distinguish sexes in *C. zebra*. There is disparity in the size of their jowls, and the hemipenes of mature males form a bulge behind the cloaca. In some males, the hemipenes can be manually everted by gently rolling ones thumb laterally from dorsal to ventral 3 to 4 cm caudal to the cloaca. If the hemipenes do not readily evert, the animal will need to be anesthetized. Rough handling of this procedure may cause damage to the hemipenes (2). Females tend to have scars, on the neck and pelvis from bites of males during courtship and copulation. These scars may not be especially noticeable if the female has shed several times since the last copulation. Some males may also have fight scars, therefore courtship scars are supportive of other visual cues, such as jowl size and cloacal bulge, but are not definitive in sex determination.

C. zebra is found throughout the Solomon Islands (3). A sensible captive husbandry program takes into account

the natural environment of the Solomon Islands. These islands are spread over 1500 kilometers of ocean just east of Papua New Guinea. They are located between 5 and 12 degrees south of the equator, grouped in a northwest to southeast chain. The major islands are very similar, each having a mountainous spine covered with dense tropical rain forests (4). Freshwater rivers are numerous except on the smallest islands, and several active volcanos are present throughout the Solomons. Guadalcanal is somewhat unique since a broad grassy plain is present along its north coast. From swampy coast to densely forested interiors to mountains peaking 3,000 meters above sea level, the Solomon Islands encompass a variety of biotopes (5).

A constant seawind tends to moderate the tropical climate of the Solomons. The maximum day temperatures noted for Honiara, Guadalcanal (the capital city) were consistently 30° to 31° C (86° to 88° F), with humidity averaging 73% monthly. Daytime temperatures throughout the island can range from 26° to 33° C (78° to 91° F), generally falling only 3° to 5° C (5° to 9° F) at night (4). Temperatures below 19° C (66° F) are reported even at low elevations year-round. Dry weather, heralded by southeasterly tradewinds, lasts from April to October. Monsoons arrive out of the northwest, bringing warmer and wetter weather to the islands from November to March. Up to 1300 centimeters of rain may fall during the year on some islands, but 350 centimeters yearly is the average for most areas. A short dusk is typical in tropical latitudes, followed by a 12-hour-long night. The prehensile-tailed skinks have been collected at the lower elevations (6), so captive husbandry conditions should keep this in mind.

Important aspects of a cage suitable for prehensile-tailed skinks include a tropical photoperiod, high humidity, appropriate variations in day and night temperature and plenty of room. There

are few reports on the captive husbandry of *C. zebra*, (1,7,8,9,11). As of mid-1992 the Philadelphia Zoo holds 3.12.4 animals (3 males, 12 females, 4 of unknown sex) and has produced 27 surviving offspring including six F-2 skinks.

Husbandry Requirements

The Philadelphia Zoo kept their original breeding group of 1.2 skinks on display in a roughly cubical case (1520 cm per side) (7). A 12-hour photoperiod was provided that included 8 hours of irradiation from a 275 watt sunlamp that was suspended 100 cm overhead. The relative humidity averaged 68% with temperature ranging from 26° to 29° C (79° to 84° F). Three offspring were produced under these conditions. The sunlamp was not provided to off-exhibit colonies, yet seven young were born to these other two groups. It is still unknown if the presence of a sunlamp or other artificial lighting contributes in any way to the reproductive success of captive groups of prehensile-tailed skinks.

The Zurich Zoo maintained prehensile-tailed skinks in smaller terraria (100 by 160 by 240 cm) (8,9). Broad spectrum lamps (Vita-lite, Durotest Corp.) provided an unspecified photoperiod and a 150 watt incandescent spotlight was used to keep the daytime temperatures ranging from 26° to 30° C (79° to 86° F). Temperatures were allowed to fall around 10°

C (18° F) at night. In addition to water bowls, the vivaria were misted daily with lukewarm water. Croton plants (*Codiaeum sp*) were used in landscaping the vivaria.

Minimal accommodations for a compatible pair of *C. zebra* consist of a cage at least 150 (length) by 80 by 80 cm. Hardwood branches for climbing should be securely fastened in the cage. One or more retreats such as hollow logs, cork bark or plastic dishpans are necessary to minimize aggressive interactions. Sphagnum moss is the author's preferred substrate in drier parts of the country because it retains moisture and helps elevate the humidity which in turn may prevent common skin problems (2). However, problems with using sphagnum moss include expense, availability, sanitation and pest control. Even with meticulous daily spot cleaning of a cage containing sphagnum moss, the entire substrate should be replaced periodically due to the build up of urates, feces and uneaten food. Rigorous attention is required to prevent the cages from becoming roach-infested. Other substrate options include cypress mulch, aspen shavings, alfalfa pellets and newspaper. The substrate that works best in any given situation will vary.

Some access to sunlight is probably beneficial since some nocturnal reptiles will emerge during the day for brief periods. If natural sunlight can not be

provided for a full 12-hour period, the photoperiod can be extended with a 40 watt Vita-lite or other broad spectrum fluorescent light. Daytime temperatures should be between 28°-33° C (82° to 91° F). Despite their arboreal proclivities, captive skinks spend a large portion of their time on the ground and thus temperature can be maintained by heat-tape or other ground based radiant heat sources. A decrease of 5°-10° C (9° to 18° F) at night is recommended. Occasional drops to temperatures of 19°-20° C (66° to 68° F) for a brief period may be beneficial.

A wet season should be provided by daily saturations from November to April. Proper drainage is essential to prevent standing water in the cage. During the drier months the enclosure should be misted with water as needed to keep the bottom layer of sphagnum moss damp. A drip system to provide daily moisture may be installed, but the irrigation lines should be kept out of reach of the skinks, as they may chew through the lines. Improper humidity can result in dysecdysis and possible skin disease (2). Clean potable water should always be available in a low-sided bowl. Some animals routinely defecate in the water bowl. If this happens, the bowl should be cleaned and disinfected immediately.

Captive Diets

The ideal captive diet for this skink is unknown, but a produce mix has been used at the Philadelphia Zoo (7) and is listed along with partial nutrient analysis in table 1. These rations were based on a vitamin D-3 level of 5,000 IU per kg of food, a vitamin A to D ratio of 10:1, and a vitamin A to E ratio of 100:1. Produce is chopped and grated into a mixture then top dressed with a vitamin and mineral blend and offered *ad libitum* twice weekly. Because the skinks' feces were soft on these rations, one tablespoon of ground alfalfa pellets was added per cup of the produce mixture. This made the feces consistently firmer. Initially many of the skinks were reluctant to consume the alfalfa pellet-enriched ration and the alfalfa pellets had to be restricted to the top dressing. It was then gradually increased to the current level. Acceptance of ration 2 (with oranges) was not good for certain individuals. It has been discontinued.

The Zurich Zoo offered fruit (pears, apples, cherries), carrots, beans, lettuce, cooked eggs (presumably hard boiled) and both raw and cooked meat. This diet was presented every third evening. Cal-

TABLE 1: Nutrient composition (as fed basis) of the rations for *Corucia zebra* at the Philadelphia Zoo during 1991.

Ration 1, fed every Tuesday	% Crude Protein	% Crude Fiber	A (IU/gm)	D	E mg/kg
5.5 lbs raw endive escarole	1.25	0.9	-	0	-
22 lbs raw kale	4.3	1.7	-	0	-
6 hard-boiled eggs	12.1	0	5.2	-	-
13.5 lbs apples	0.22	1.0	0.9	-	8.7
50 lbs carrots	1.1	1.0	110	0	4.9
11.5 lbs peeled bananas	1.1	0.5	1.9	0	5.0
Top dressing:					
18 tbsp mineral mix	15.2	0.1	0.14	0	4.0
5.4 tbsp dried cottage cheese	82.0	1.0	1.4	-	-
2.7 tbsp Vionate powder	-	-	221	22	20
4 tbsp bone meal mix	17.8	-	-	-	-
Total for ration 1	1.9	1.1	54	.01	4.1
Ration 2, fed every Friday					
Same ration as Tuesday ration with addition of:					
11.5 lbs raw peeled oranges	0.8	-	-	0	2.0
Total for ration 2	1.9	1.0	53	.01	3.8

cium, Vionate and crushed dried shrimp were used as supplements. Fresh shoots of vivaria plants such as *Scindapsus* and *Monstera* were eagerly accepted.

Many freshly imported skinks will immediately start eating a mixed salad ration such as described for green iguanas (10), including alfalfa pellets and soaked monkey biscuits. Monkey chow biscuits should not exceed 10% of the total ration because of their high vitamin D content.

Initially, some skinks may refuse to eat salad, and other options must be tried. One food that seems to be preferred during acclimation is a mixture of sweet potato baby food and soaked monkey biscuits (Zupreem brand) (11). Oily monkey biscuits, such as some of the bargain brands, are not well received, and it should be noted that there is considerable variation in the vitamin and mineral composition of various brands. Pothos shoots are also avidly consumed during acclimation. Sweet potato baby food tempts many finicky skinks to eat and gradually other baby foods are accepted (eg., butternut squash, chicken vegetable, apricot, peach, banana, plum, apple-blueberry). After acclimation, dietary preferences expand in most individuals. Monkey biscuits should be tapered off and replaced by canned yams, fresh shredded sweet potatoes, romaine lettuce, grated carrots, red and green peppers, banana, apple, parsnip, papaya, pear, corn, green beans and canned fruit cocktail. The staple diet (including monkey biscuits and alfalfa pellets) should be offered thrice weekly, with vitamins (Nekton Rep) and ground oystershell mixed into the food every other feeding. Oystershell is a preferred source of calcium because it is solely composed of calcium carbonate, which helps offset the inverse calcium to phosphorus ratio found in many items of produce. Supplementation with Nekton-Rep is recommended despite the fact that monkey biscuits are fortified, because the author doubts that the vitamin mineral composition suitable for primates is entirely appropriate for prehensile-tailed skinks. Salad should comprise at least 80% to 90% of the diet.

When skinks are obviously hungry, pacing the cage and flicking their tongues, they are not as discriminating as when they are only slightly hungry. It is at this time that new items are most likely to be accepted. Food should be offered within one-half hour of sunset.

Prehensile-tailed skinks will become habituated to certain food items which

can lead to nutritional problems. For this reason it is imperative that the salad be thoroughly mixed so that a finicky animal cannot pick and choose favored food items. Iceberg lettuce should be avoided.

A habit that is consistently noted is coprophagia. Any skink will devour feces from itself or another skink. There is a peculiar odor to the feces of captive *C. zebra*. This odor may allow skinks in the wild to track down their feces for consumption. Whether or not coprophagia is necessary for the uptake of B and K vitamins or to increase the utilization of vegetation (as it is in some mammals) is unknown. It is difficult to prevent coprophagia, but it is probably not detrimental if skinks are deparasitized during quarantine and follow-up fecal exams have not demonstrated parasite ova. Coprophagia may aid young skinks in the process of establishing normal gut fauna.

C. zebra shed about every two to four months, generally in several pieces as is usual for lizards. The tail shed comes off in one piece that resembles a Chinese finger trap. Keratophagy is common.

Captive Propagation

Reproductive behavior at the Philadelphia Zoo may have been initially stimulated by the addition of large hollow logs to the vivaria. Copulation followed after a typical lizard courtship. The Zurick Zoo reported similar findings. Copulation lasts from four to seven minutes. The male skink bites the female's neck during copulation. This probably causes the scars seen on the necks of mature females. Copulation was noted only after sunset. Gestation apparently lasts at least six to seven months, and *C. zebra* are viviparous. The group of skinks at the Philadelphia Zoo do not appear to be seasonal breeders, as births have been reported throughout the year. This group is not exposed to variations in temperature, humidity or photoperiod and thus is unlikely to reflect the cyclicity of reproduction in wild populations. Given the longevity of this species, the prolonged gestation period and the size of the newborns, there is a distinct possibility that female skinks may have a triennial or quadrennial reproductive cycle.

Based upon the author's observation, establishing a seasonal cycle of wet and dry seasons along with the appropriate temperature fluctuation will stimulate breeding in captive *C. zebra*. Some

skinks are stimulated to copulate by drenching the cage with water periodically during the "wet season". Copulation occurs around sunset during the cooler wet months. Courtship activities tend to decrease when temperatures consistently exceed 31° C (88° F). At Philadelphia Zoo the photoperiod is maintained throughout the year at approximately 12 to 13 hours of light daily.

The young are very large at birth, often weighing over 80 grams. One to two young are produced per reproductive cycle. Twin births are not unusual, with the weights of twins ranging from 35 to 50 grams each. Neonates can be over 30 centimeters in total body length. Some babies have bright yellow heads and there are reports of solid orange young (11). Neonates usually do not feed until their first shed nine to eleven days post-partum. The birth membranes are presumably eaten by the mother, although in the blue-tongue skink (*Tiliqua spp.*) the young are known to consume the membranes. Parental care is evident as the mother is quite aggressive to intruders. The neonates are also aggressive toward intruders, including skinks other than their mother. Since neonates have been cannibalized by adults, the Zurich Zoo separates known gravid females. Postnatal care of the mothers at Zurich consisted of multivitamin shots and separate enclosures for several weeks before reintroduction to the breeding colony. The Philadelphia Zoo keeps mother and young in the colony at all times.

Unfortunately, many neonates fail to live longer than 30 days. The causes for this are unknown, but may be associated with improper husbandry of the young, poor maternal nutrition, ascending umbilical infections and other as yet unidentified factors (2).

Common Problems in Captivity

Trauma caused by cagemate aggression is common. Unfortunately, *C. zebra* will fight to the point of serious injury or death. Intraspecific aggression may be alleviated by larger accommodations which allow subordinate animals to retreat from dominant animals. Reports of behavior in the wild indicate that three skinks will stake out territories on the same tree with the dominant skink having the highest position and the best food source (6).

The use of an introduction box may lessen the stress of introducing a new animal to an established group, but this

is no guarantee of success. An introduction box should be covered on one end with fine screen or mesh. This will allow skinks to investigate each other without being able to physically attack each other. If larger mesh is used, the skinks may bite at toes and tail tips that poke through the gaps in the screening. Once the new animal seems to be accepted, it may be let out of the box and observed to determine compatibility with the group. Some animals remain incompatible and can never coexist in the same cage. It is the author's impression that a dominance hierarchy becomes established in captive groups.

Infectious conditions such as parasitism, salmonella enteritis and other bacterial infections are common (2,11). Skinks should be deparasitized upon acquisition. A quarantine period of 60 days is recommended, and each animal should be given a thorough examination prior to release into a collection. Baseline hemograms and serum chemistries are recommended and may be compared with normal values (12). Routine fecal parasite examination and appropriate anthelmintic treatment is recommended for all prehensile-tailed skinks.

Status in the Wild

Agriculture accounts for most of the cash economy of the Solomons, although subsistence economy accounts for one-third of the gross domestic product. Coconut, coco and oil palm are the main cash crops, and at present are mainly under the control of small holders or family management. Unfortunately, slash and burn agriculture is increasing in direct proportion to the population expansion. Livestock, such as cattle, swine and poultry, are gaining prominence at the expense of the indigenous ecology. If managed improperly, the agricultural industry could result in devastating changes in the unique floral communities and subsequent extinction of many endemic animal species.

Timber is the main export of the Solomons, sold primarily to Japan and Korea. There are over 2.5 million hectares of forests covering the islands, but less than 1% of this was considered exploitable until the late 1980s. Modern logging operations have opened up previously virgin forest. This is in part responsible for the sudden availability of herpetofauna from this region. The livestock and timber industry are the biggest threats to the ecological stability of these islands. The world community has

recognized the fragility of the tropical forest ecosystems on the Solomons, but this does not necessarily translate into effective protection.

Future efforts with *C. zebra* should include the establishment of self-supporting colonies. The prehensile-tailed skink has a low reproductive rate. It would take years for this species to recover from moderate depopulation in an area. This low reproductive rate is the very reason the prehensile-tailed skinks are in need of captive propagation. The Solomon Islands are undergoing massive changes and, as a result, a number of endemic species of plants and animals are threatened. It would be impossible for any one private individual or institution to house a colony of skinks that would be large enough to have sufficient genetic diversity to ensure a self-sustaining population, so a network of private and public breeders will be essential to the survival of this species.

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